Polypropylene Ankle Foot Orthosis

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In this study assessment of Polypropylene Ankle foot Orthoses: TIRR, Molded and Posterior Solid Ankle were made for various patients with below knee impairements. Criteria for their prescription are evaluated in reference to its utility and effectiveness in our circumstances.

It has long been felt that the conventional double bar below knee orthoses do not adequately meet the needs of individual patients. It is not only women but also men object to its conspicuous appearance. They are heavy weight. The metallic joints are noisy and liable to wear out. Use of lubricants soil clothes. The patient is not allowed interchangeability of the shoes and with gradual disappearance of leather sole shoes, considerable difficulty is experienced in providing suitable footwear for attaching the footpins in the conventional orthosis.

Biomechanical Considerations

The major drawback with the conventional metallic orthoses are biomechanical considerations. The work of Inman and Associates (1978) had radically modified our understanding for the foot and ankle mechanics. An orthosis must provide for individual tibial torsion and toe out. It must have adjustments for specific inclinations of the axis of ankle joint, subtalar joint and transverse tarsal joints and their movements. Likewise an orthosis should allow for transeverse rotation of components of lower limb which are transmitted from talus to tibia and vice versa.

But, the conventional orthosis does not provide for congruence of anatomic and orthotic ankle joint. This incongruence causes undue foot discomfort and/or deformity. This lack of alignment also results from failure to accomodate for individual tibial torsion and toeout in the brace. This bracing, is infact overbracing in some patients—as it does not allow subtalar movements and the orthosis prevents normal plantar flexion after heelstrike, even in case of just dorsiflexor weakness.

These were some of the factors which lead to development of newer designs of the Ankle Foot Orthoses or FAO. These newer designs were possible because of availability of thermoplastics like Polypropylene, Polyethylene, Ortholen etc. Plastics did not simply subsitute for metal but a newer designs concept was developed (Lehneis). In fact Sarno and Lehneis (1971) Stated that there is no longer any indication for prescription of conventional FAO. All such requirements can be fulfilled by newer plastic orthoses.

MATERIAL AND METHODS

In this study, conducted at Rehabilitation Research Center, SMS Hospital, Jaipur, an attempt was made to prescribe twentyfive plastic AFO's in place of Conventional FAO. Patients with below knee impairements were evaluated, their history of illness, progress, patient's experience with previous brace (if any), his environmental demands, his shoe wearing habits—all were noted. Through Physical examination was carried out to record motor and sensory deficit, medio-lateral instability, spasti-

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city, fixed deformities of ankle foot complex, oedema and abnormal movements, patient's gait pattern with and without shoes and with previous brace, if any, were also noted. Then an attempt was made to classify patients on the basis of impairements and prescribe polypropylene AFO following Sarno (1979). Only three types of AFO's were designed and prescribed.

(i) Molded AFO as described by Melvin Stilles and AB Wilson (1975);
(ii) TIRR AFO as described by Engen (1972); and
(iii) Polypropylene posterior solid ankle AFO designed by Sarno and Lehneis (1973).

After fitting and checkout, the patients were followed at two months interval. Following points were noted at check out and followup clinics :—

I. Breakage in the shoe and orthosis.
II. Capacity of device to control deformities and help in improvement in the gait pattern.
III. Patient's view about orthosis—its advantages and disadvantages over previous brace, weight, cosmetic factor, comfort and strength or otherwise.
IV. Pressure spots.
V. Clinician's opinion regarding device.

The main weightage was given to improvement in the gait pattern and patient's acceptance, in Indian environment. All these orthoses were made at our center.

OBSERVATIONS

The main purpose of this study was to assess the feasibility, acceptability and effectiveness of polypropylene AFOs in our patients. The prescription criterias laid down by Sarno and Engen were also assessed for their utility in our setup. In this study, twenty-five AFOs were fitted on twenty-one patients. The major bulk of our cases had lower motor neuron paralysis. Twelve AFOs were fitted for residual poliomyelitis; two each for Sciatic nerve injury, Meningomyelocele and Peroneal Muscular Dystrophy and one each of Pantalar fusion, Lateral Popeteal nerve palsy, post head injury hemiplegia and residual paralysis after cervical spine injury. Rest of the three cases had cerebral palsy. Ten fittings were made for patients above 12 years., eleven for those between 3 years. and 12 years. while rest were under 3 years. TIRR AFO, Molded AFO and PSA AFOs were provided for eighteen, six and one case respectively. In two cases where molded AFO was used, three point pressure system was incorporated for the mediolateral instability.

Five cases developed pressure sores at/or around malleoli, two of these had sensory deficit. On the contrary, two cases with sensory deficit did not develop sores. This emphasises that pressure sores were not due to sensory deficit but due to irregular sharp margins or tight fitting at the ankle area of the orthoses.

One case who was using a toe raising spring previously, used to twist/invert his foot during fast walking or on uneven grounds. He was immensly satisfied with the TIRR AFO. Another case with spastic hemiplegia had proprioceptive sensory deficit and had to glue his eyes to floor while walking. A TIRR AFO with total contact at sole and calf and transmission of sensory impulses provided him with adequate proprioceptive feedback. A case which was provided with posterior solid ankle AFO to hold all movements at ankle and foot, was also provided with SACH wedge, steel shank and rocker bottom in his shoe to allow heel-toe gait pattern. This patient had better gait pattern but the device was little flexible and allowed some mobility. Two cases with calcaneus deformity were provided with Molded AFO, but results were not satisfactory. A case with severe spasticity was fitted TIRR AFO, which was not sufficient to control spasticity. Some affluent patients were extremely happy because of lack of conspicuousness and interchangebility of shoes allowed

with these orthoses. But many did not like to wear closed shoes or to wear shoes with his dhoti. These orthoses were more difficult to make as they were tailor made for patients; they were expensive and used to break within six months particularly in adolescents and adults.

DISCUSSION

In 1970, Committee on Prosthetic Research and Development of the USA identified eleven designs of newer AFOs. These included TIRR AFO, IRM (New York), Spiral and Hemispiral AFOs, VAPC shoes clasp AFO, UC BL dual axis AFO, NVU shoe insert AFO, and IRM Posterior solid ankle AFO. Teufel AFO was made from Ortholen in the West Germany. Thermoplastic used for the spiral and hemispiral AFOs is Plexidure. Lehmann (1979) has reviewed the basic biomechanical principles used in fitting a patient with ankle foot orthoses. Depending upon the amount of plantarflexion and dorsiflexion which is allowed by plantarflexion stop, knee instability is either minimal or maximal. If more is the dorsiflexion provided at the ankle, the better is the clearance during swing phase but the bending moment at the knee is also greater, which must be overcome by voluntary effort. The more is plantar flexion provided, toes drag more but less is knee bending movement at the knee. This principle can be used for providing stability at the knee with the help of AFOs. Lehmann also stated that such bending movement can be reduced by heel wedge like in the SACH wedge. Further according to him, effectiveness of the plastic AFO can be determined by manually twisting into dorsiflexion, plantarflexion or mediolaterally. Orthotic's influence on the knee can also be estimated.

The rigidity/flexibility of the TIRR AFO can be selectively adjusted by material left at the cross sectional area, (Engen, 1972).

Our experience with these orthoses make us to believe that these have to be used very selectively. The polypropylene posterior solid ankle AFO is indicated in patients with severe spasticity, moderate to severe mediolateral instability, severe sensory and proprioceptive loss, flail ankle foot complex and in patients with pain in the ankle joint due to arthritis. The TIRR and Molded AFO, both can be prescribed for the patients with Sarno's Type I and Type II impairements. In more than milder degree of mediolateral instability, a molded AFO can be used along with incorporation of the three point pressure system. TIRR AFO is also preferred by patients because of skin ventilation.

Inspite of higher cost, higher breakage rate and technically greater difficulty to tailor made such orthoses, patient acceptance rate has been higher.

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